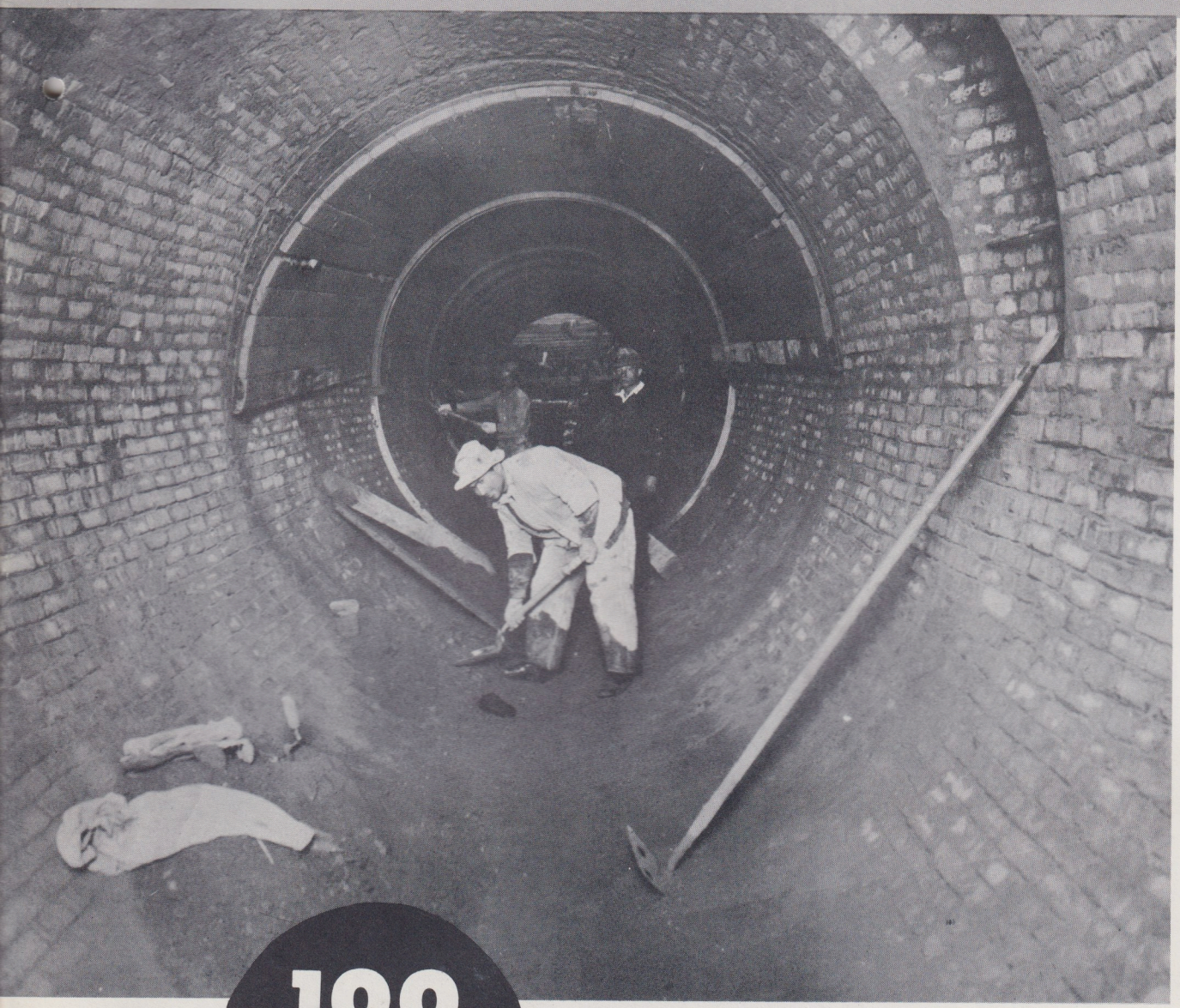
1856 - 1956

the Chicago Sewer System



100 years of

PROTECTING CHICAGO'S HEALTH

Richard J. Daley
mayor

DEPARTMENT OF WATER AND SEWERS

JAMES W. JARDINE
Commissioner of Water and Sewers

BUREAU OF SEWERS

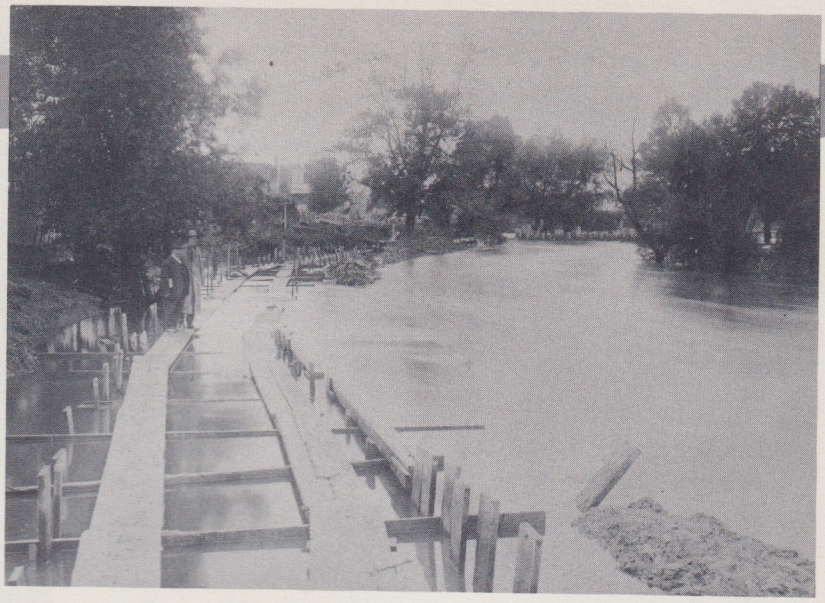
THOMAS D. GARRY
Deputy for Sewers

FOREWORD

Besides recognition of the Centennial of the Chicago Sewer System, it is intended that this booklet may be useful as an answer to some of the many inquiries for general information as to that System.

Under the general direction of A. J. Schafmayer, Chief Engineer of Sewers, and H. M. Forrey, Assistant Chief Engineer, the text and the format are the work of T. S. Ford, Engineer —Bureau of Sewers, and James Moorman of the staff of the Department of Water and Sewers.

Thos. D. Garry



Flood, North Branch Chicago River at St. Louis Ave.—1915.

79th St. sewer near Western Ave.—1924.

Indianapolis Ave. at 103rd St.—1925.

One hundred years ago last December 31 (1955) the Board of Sewerage Commissioners of the City of Chicago published the following:

NOTICE

Sewerage Commissioners' Office
Chicago, Ill., Dec. 31, 1855.

The Board of Sewerage Commissioners hereby give notice that they have fixed upon the Plan of Sewerage specified in this publication, for the three Districts of the City, and they will receive written objections to the same, at any time within thirty days of the date hereof.

W. B. Ogden
J. B. Webster
S. Lind
} Sewerage Commissioners

This action was pursuant to the Board's adoption of a report by its Chief Engineer, E. S. Chesbrough, outlining a system of sewers "to cover at present, that part of the City included by Division Street, Reuben Street (Ashland Avenue), North Street (16th Street), and Lake Michigan." This area was about seven square miles out of the 18 square miles then covered by Chicago.

In this system, sewers south of the river and east of State Street were to drain east into Michigan Avenue and thence north to the river or south to 12th Street and to the Lake. West of State and north of Washington would drain north to the main river but south of Washington would go west to the South Branch. Mains for the west district were to be in Prairie (Fulton Street), Randolph, Monroe (Adams and Madison Streets were later substituted for Monroe), and Van Buren Streets and extend as far as the then existing improvements required, leaving extensions for a later date.

BRICK SEWER CONSTRUCTION

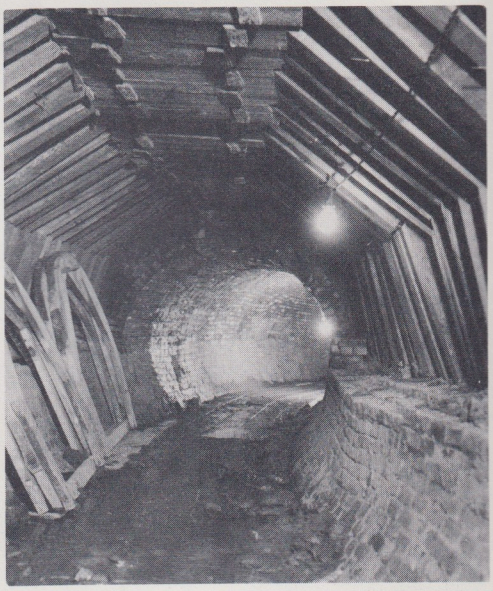
Starting a "Bottom".

On the north side, mains in Rush, Clark, and Franklin Streets were to drain south to the main river and one on Chicago Avenue would go west to the north branch. Nothing north of the river would drain to the lake since that was considered rather close to the water intake at Chicago Avenue! The mains were all to be round tubes and, on the west and north sides (excepting Clark Street which was 6 feet), were to be 5 feet in diameter at their outlets and were to be built of locally made brick, decreasing gradually to 2 feet as they went further away from the river. Sewers less than 2 feet were to be of tile pipe 12 inches or 15 inches in size.

The spur behind a project of this size and the willingness of the authorities to recommend it at a cost of a million dollars or more was the recurrence, for several years, of the 1847 epidemics of Asiatic cholera and diphtheria that had taken thousands of lives.

In the Chicago Tribune of January 5, 1856 was the following editorial:

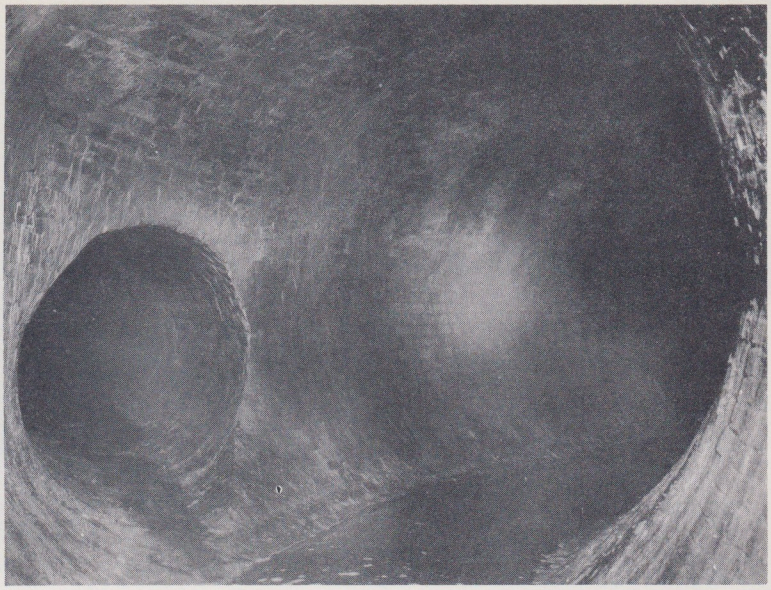
"The sewerage question is the thing of more vital importance than all other questions besides. It may be neglected this year and the next and maybe one-half dozen years yet to come when so much of the health, prosperity, and population will hinge upon it that it cannot longer be deferred * *. The plan recently matured by Mr. Chesbrough is before the taxpayers for adoption or rejection * *. We have all the time been aware of the care and labor with which it has been eliminated, and we see no reason why it should



6½-foot-sewer in tunnel.

9-foot sewer in open country.

11-foot branch from 16-foot sewer.



3½-foot-branch—52nd St. at Central Ave.

not meet with a general and hearty concurrence. It may be * * that practical difficulties may arise * * but * * it appears to be * * the best * * that engineering skill can devise * * within the City's means to execute.

"It embraces all the territory that the City is at present able to drain; it admits of indefinite extension to meet whatever wants may be hereafter developed; it is founded on the results of patient and rigid experiments made elsewhere and, if adopted and carried out according to the intention of those who devised it, there can be no reasonable doubt that it will accomplish all that is desired.

"Our readers will be gratified to know that the fears that the City of Chicago would not admit of perfect drainage are all unfounded, and that the topographical facts of the City's location are those the most favorable to the easy working of the system now most esteemed by all the leading engineers who have given the matter of sewerage their attention; * * that the altitudes and depressions of the surface are as great as are needed; and that the relation of the lake to the City's site, heretofore deemed the great obstacle to be overcome, * * proves * * of infinite advantage * * as it makes the adoption of the flushing system easier than in any other City in the country."

Chesbrough's conclusions and his discussion of the engineering and economic aspects of the problems might easily pass in the present day, except for matters of which nothing was then known. Most of his conclusions were wise and many were, for that time, far-sighted—even those concerning flooded basements and the necessity of raising street grades so as to allow sufficient pitch in the sewers.

During 1856, sewers in the present "Loop" district were built and, by 1861 Chicago covered 18 square miles, and had 54 miles of sewers with 2400 house drains connected to them, according to the earliest available report.

In the next 25 years Chicago's population increased to 750,000 and its 18 square miles to 36, but its sewage disposal problems increased even faster, although the sewers were still quite adequate. The domestic sewage of the City plus tannery wastes and packing-town refuse discharging into the north and south branches were making the Chicago River a putrid septic tank. Also, several sewers ran directly to the

8½ and 7½-foot Pratt Ave. sewers join 10½ at Glenwood Ave.

MAKING AND HANDLING LARGE CONCRETE PIPE

Pre-cast concrete pipe plant.

lake from the Town of Lake View on the north and the Village of Hyde Park on the south, and all this was causing attack after attack of typhoid and other ills. But the fact that sewage was to blame for this, became known only after Pasteur and other scientists discovered, about 1880, that those diseases are transmitted by germs and mostly through polluted water.

This second health problem caused by defective sanitation resulted in the appointment, by Mayor Carter Harrison, Sr., of a Commission of engineers headed by Rudolph Hering and directed to report "* * * upon all things which relate to the matter of water supply and drainage of the City of Chicago." The commission studied several methods for disposal of Chicago sewage and its preliminary report was made in January, 1887. It recommended that the Chicago River be connected with the Mississippi Basin by a canal to the Des Plaines River at Lockport and that an over-all authority be formed to do this and to supervise water distribution in the area.

The State Legislature passed an enabling act and, by the end of 1889, the Sanitary District of Chicago was formed to dig a canal to carry Lake Michigan water via the Fox and Illinois Rivers to the Mississippi and, with it, the sewage from Chicago and the nearby towns. The matter of water for domestic use was left to the local governments but it was already being settled the same year by proceedings for annexing the Village of Hyde Park, the towns of Lake and Jefferson, the City of Lake View, and part of Austin to Chicago. This action increased the population of the City from 850,000 to 1,070,000 or 26%, and added 200 miles of sewers (40%) to the 500 miles then in the City sewer system. The significant thing, however, was the increase of nearly 350% in the area of Chicago (from 38 to 170 square miles) which made room for the doubling of population that occurred in the next twenty years.

After financing its first sewers through bond issues, Chicago, until this annexation, used a "sewer tax" collected with the general tax but expendable only in that division (north, south, or west) in which it was collected. On the other hand, the annexed towns had been using special assessment procedure,

7½-foot pipe laid.

"Lower Away!"

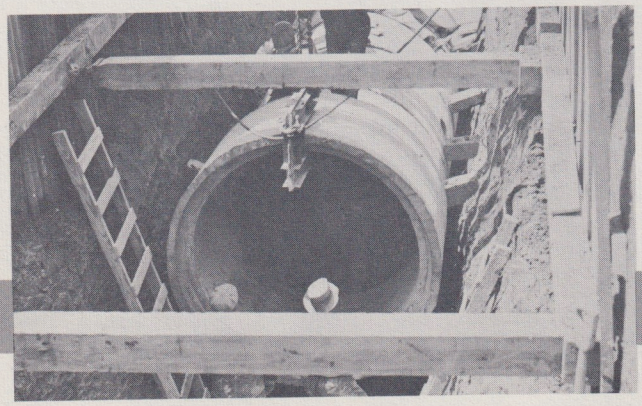
so to avoid confusion, the City adopted that method and used it until the depression in 1931 caused so much tax delinquency that special assessments were not used for nearly twenty years.

The pattern of sewerage for inner Chicago did not change much after Chesbrough set it. As City Engineer, he extended it until his death in 1885 and it has been added to greatly since. But, except for two or three outlets beyond the "divide" toward the Des Plaines River, all of Chicago north of 87th Street still discharges its domestic and commercial wastes in dry weather into "interceptors" along the lake and along the Chicago River and its branches and the canals and discharges its storm sewage directly into those streams as will be explained later.

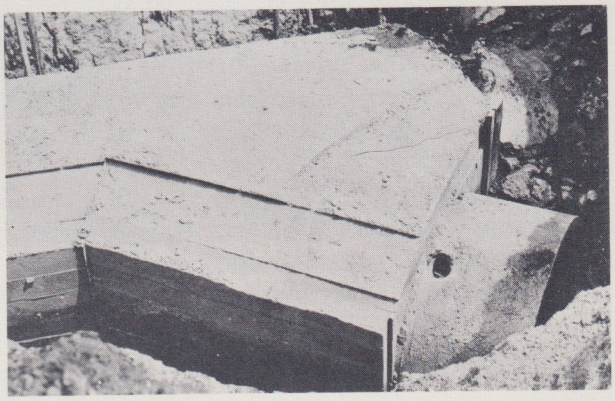
By 1900, the Sanitary District had dug the first channel—the "Sanitary and Ship Canal"—and opened it to use. In 10 more years, the North Shore Channel was opened and intercepting sewers had been built by the City near the lake-front to divert sewage from Lake Michigan. The interceptor along the South Shore discharges west through a 20 foot conduit in 39th Street to the south branch of the river and the two interceptors on the north side join at Lawrence Avenue and flow west through a 16 foot conduit to the North Shore Channel. A pumping station was built at the lake end of each of these conduits to raise the sewage to river level and also to furnish extra flushing water from the lake.

To understand the need for this pumping, it must be remembered that the old sewers of the suburbs—Hyde Park and Lake View—emptied into the lake and drained land that was in some spots only a few feet above the lake. When the interceptors were built from 39th Street to drain six miles south to 87th Street and from Lawrence Avenue to Fullerton Avenue and to Howard Street, they had to be lower than the old sewers so that, to get slope enough to carry the sewage, they had to be pumped at the low ends in order to flow to the river.

7½-foot pipe reaches bottom.



Form work for junction of 2 sewers.



Finished junction.

Both pumping stations have since been relocated by the Sanitary District at the channel outlets, as there was no further need for flushing water and the capacity of these two large sewers could be greatly increased by the change. Between the years 1911-1923, the Calumet Sag Canal was built as a barge canal and to carry sewage of the south part of the City and of the southern suburbs to the main channel above Lemont.

From the beginning, Sanitary District engineers realized that, in time, thousands of tons of sludge would accumulate in the beds of the river and main channels. With that in mind, experiments in sewage treatment were started even before the interceptors were in operation. Partial sewage treatment in settling basins and sludge removal in huge two-story septic tanks, called Imhoff tanks, began at the "Calumet" works—125th Street and Indiana Avenue—in 1922. By 1928, aeration by the "activated Sludge" process was going on

CONCRETE SEWER CONSTRUCTION

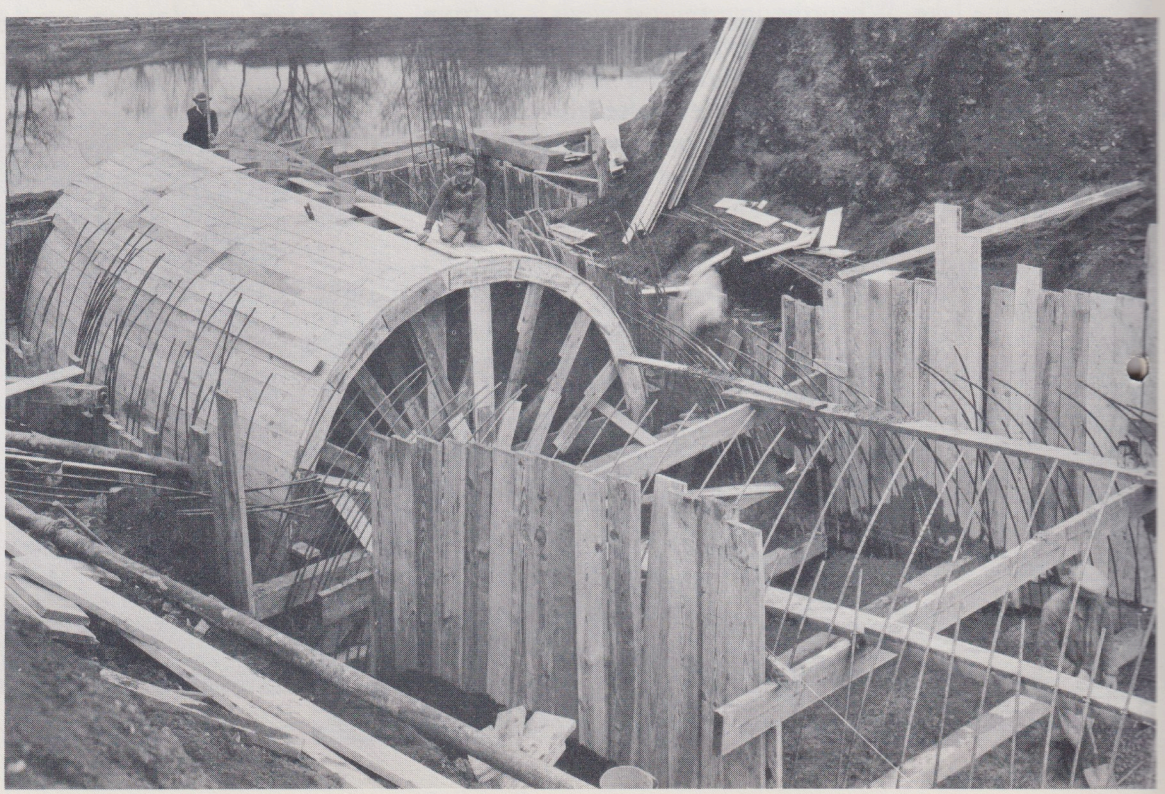
in the world's largest plant of that type, at Howard Street and Kedzie Avenue, to treat sewage from all of Chicago north of Fullerton Avenue and from several north suburbs. Shortly after, in Stickney near 4100 south and Laramie Avenue, an Imhoff tank plant was opened to treat sewage originating between Fullerton Avenue and the main channel. In the late thirties a second plant was also operating in Stickney to serve the area south of the main channel to about 87th Street. These four plants, with major additions at Calumet and at Howard Street, now permit a high degree of sewage purification for the 490 square miles of the present Sanitary District.*

*While this was being written other suburbs were to vote on the question of annexation to the reconstituted Sanitary District to be known as The Metropolitan Sanitary District of Greater Chicago.

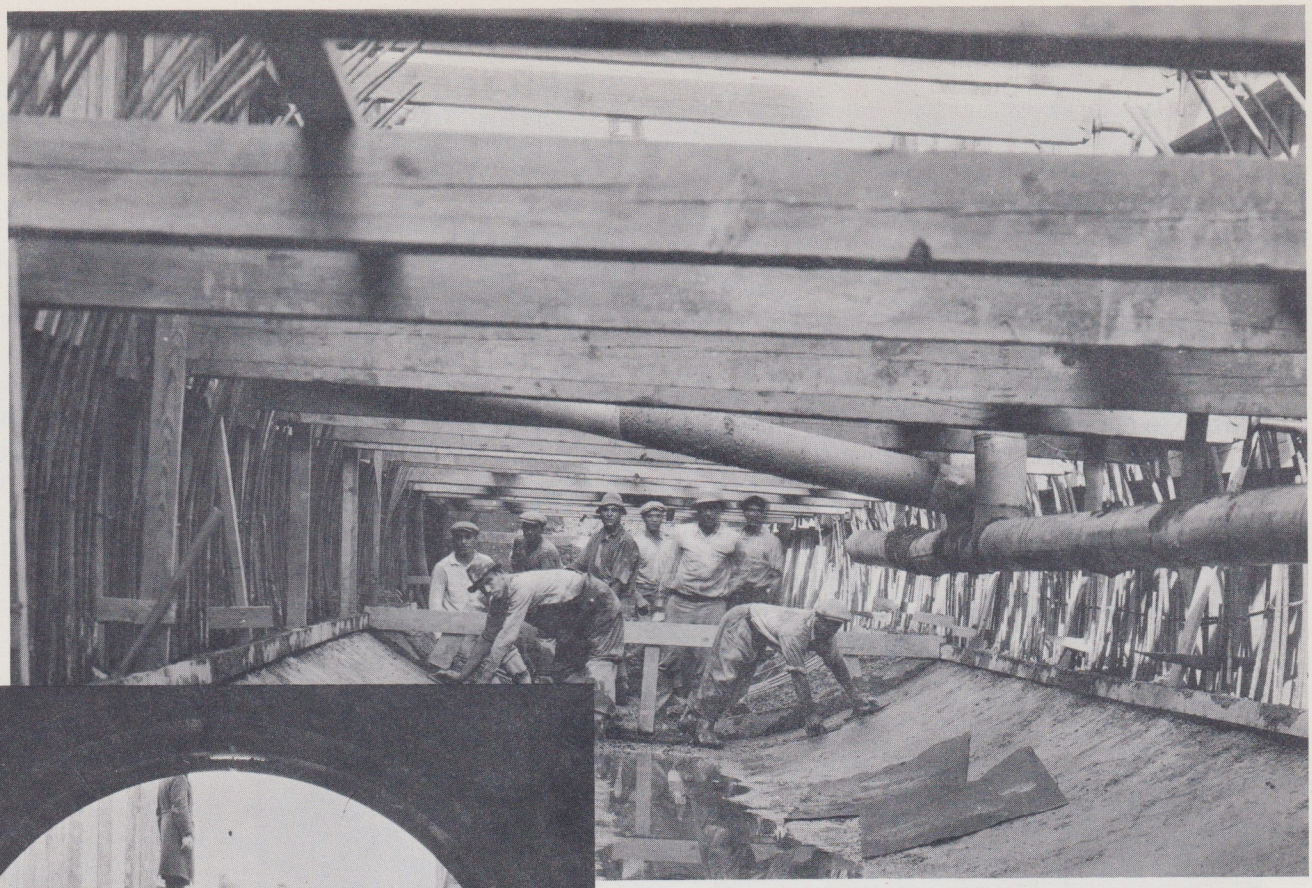
To collect this sewage from the City system, the interceptors mentioned above—from 4x5 to 20 feet in diameter—cross under the City sewers, usually near their outlets at the river or channels. In dry weather and light rains, sewage drops into these interceptors and is carried in them to the treatment plants but, in heavier weather, control gates permit the City sewers to discharge into the open streams for a few minutes to a few hours, a few times a year on the average. Ordinary sewage is very dilute, so that when there is rain enough to make it enter the streams, it is further diluted many times by the rain water.

In these ways Chicago solved its problems of water-born disease, but over the years another problem developed—that of keeping up with growth and age. Beginning in the early '90's, the increase of hard pavements and sidewalks and of the building rate and the extension of sewers beyond their original limits all began to cause greater run-off in storms than had been allowed for in the original designs, especially in the annexed towns. Thus, even during the last century, the flooding of basements had begun.

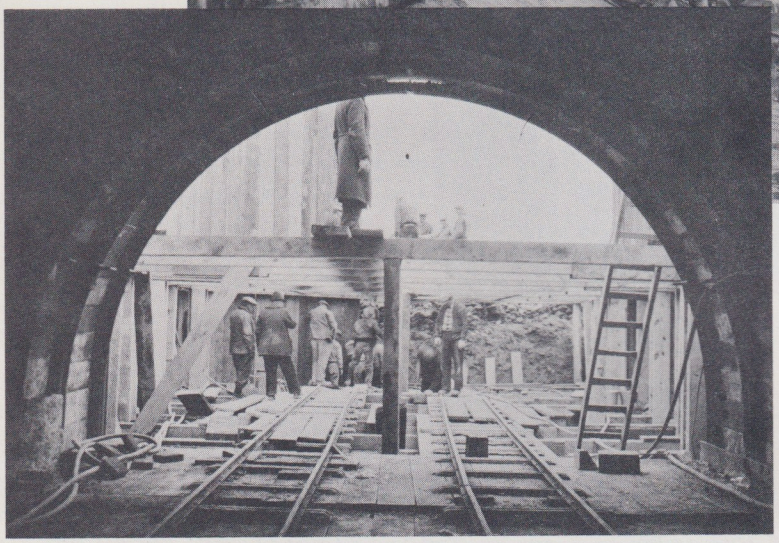
As early as 1900, the Mayor's message, in reporting a total of 1481 miles of sewers in the system, also notes that " * * 8.8 miles * * have been taken up and replaced by larger sizes * * ", and from then on, a large and complicated program of auxiliary sewer building has been in progress (with interruptions) and will continue for several years to come. Before the breakdown of special assessments in 1932, ten or more major items in this program were completed at a cost of some $13,000,000—nearly $30,000,000 at today's costs.



Forms and steel set for 14-foot sewer in Berteau Ave. at North Shore Channel.



Shaping Concrete Bottom—Monroe St.—1930.



Looking out. 18-foot Kilbourn Ave. sewer near main drainage channel.

After three or four years of complete shut-down, sewer construction was resumed in 1935 as a W.P.A. project under the Federal public works program. The City had a backlog of plans in all stages of preparation including two to three million dollars worth ready for use at once, so that by the time work stopped in the summer of 1941, just before World War II, another seventeen items of the general plan for sewer relief had been completed—valued at over $20,000,000 at that day's prices. At the same time both new and auxiliary local sewers of nearly equal value had been laid in large areas already built up but either lacking sewers entirely or without those of sufficient size. During World War II (and until 1948,) only 36 miles of sewers were added to the system—mostly in small sizes built for war plants and housing projects.

About 1944, in anticipation of the return of a large number of men from the army and from war production to peace-time industry, a prominent place in the readjustment program was given to public works, including of course, sewer construction. Expansion of war industry had developed sprawling one story factories and had added thousands of new houses with basements subject to flooding and these, with the building of wider roads and large parking spaces, had increased flooding in sewers already overloaded and traffic delays at flooded underpasses.

But a method of financing new work was still undetermined. Special assessments are not only difficult to spread for large sewer projects (because of legal requirements for "direct" and "indirect" benefits) but they were then impracticable for lack of a market for assessment bonds.

Many cities, small and large, all over the country were adopting a charge for sewer service. But such financing in Chicago could furnish enough money for large construction only after several years to build up a sufficient fund. Meantime it would be expected to pay for maintenance as well. The Bureau of Sewers

MORGAN ST.—1952

Trench 50 feet wide.

advocated such a charge then (and still does) for long-term financing of its work, but realized that for quick results, general bonds of the City would be the only available source.

What now seems to have been short-sighted opposition to approval of sewer bonds developed among influential civic and commercial organizations and the press was united against them. But, in spite of this, a bond issue of $58,000,000 was voted in the referendum of June, 1946 and was validated several months later by the courts.

Shortly after this the State Legislature adopted an amendment to the Motor Fuel Act permitting allocation, from the City's share of motor-fuel taxes, of funds to pay for a percentage of each Bond-Issue sewer project. The proportions vary with the sewer districts and are subject to approval by the State Highway Division.

Late in 1946 a special planning unit was formed in the Bureau of Sewers and, by the summer of 1947, the first auxiliary sewer project was under contract. In the nine years that have followed 42 more units, ranging in cost from $82,000 to $3,100,000 each, have been completed or are in progress. Committments to be made this year (1956) will just about exhaust the bonds of the 1946 issue, but the memory of the severe floods of 1954 helped to break down the opposition to sewer bonds, so that $30,000,000 more was voted in the spring of 1955. This will permit present projects to continue and will allow a good start on relief for other parts of the City which have been hard hit by the expansion of industry and by home building. BUT IT WILL NOT FINISH THE JOB.

As of now, the system contains over 3600 miles of sewers from 10-inch tile pipes to 18 or 20-foot brick or concrete conduits; 132,000 manholes allow access to them for inspection, cleaning, and repairs; and 192,000 catch basins collect most of the heavy dirt and grit and prevent it from getting into the mains. There are about 450,000 connections to the sewers, ranging between 6 inches and 4 or 5 feet in size, for dwellings or for industry. Of this huge network of sewers, more than 200 miles are 6 feet in size or over—large enough to walk through—and another 200 miles are 4 to 5½ feet and may also be entered for inspection, if necessary.

Interruptions to the progress of the sewer program and the unheard-of boom in building have frequently caused property owners, in parts of the City subject to flooding, to heap criticism and abuse on city officials who have inherited a system built by others and under

many and different circumstances. People often ask, "Why did the City permit sewers to be built too small?"

For one answer, read again the second paragraph quoted from the Tribune of 1856 to see how that generation thought, mistakenly, that it was providing for a long time ahead. Then too, when large outlying areas were being assessed for sewers, the "economy bug" got in its bite. Objectors insisted that the land could never benefit to the amount of the assessments. In most cases they were wrong, since the mere building of a sewer through such land sent values higher. But because of the objection—a valid one in court in assessment cases—many sewers were "economy size" —and not in the modern advertising sense of those words. Anything designed with a look far ahead was called the "extravagant dream of engineers," and was often cut down by the court to fit owners' ideas.

When a sewer is designed to carry storm water at the same time with sanitary sewage—that is, domestic and industrial wastes—the capacity must be 25 times

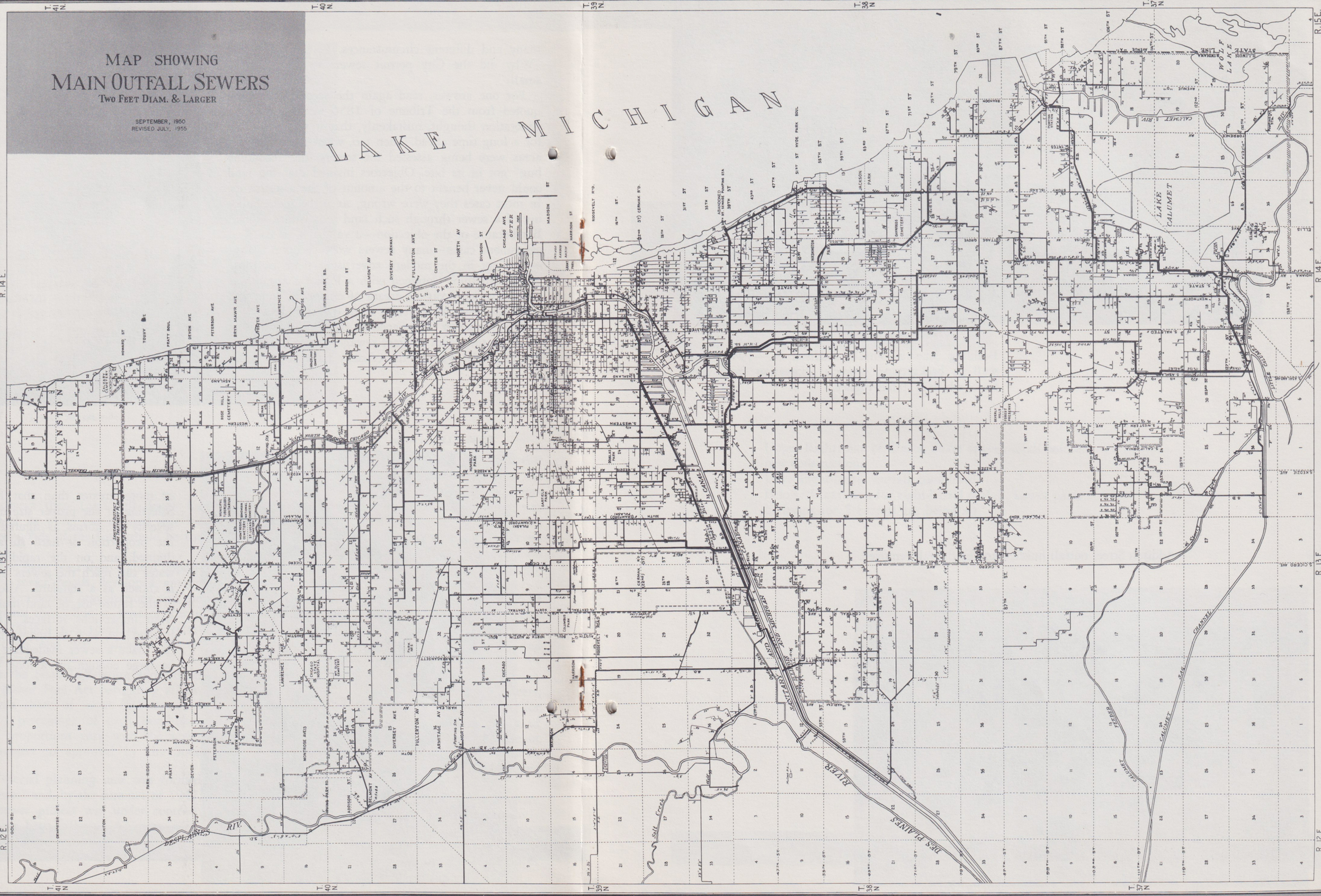
Trench 38 feet deep.

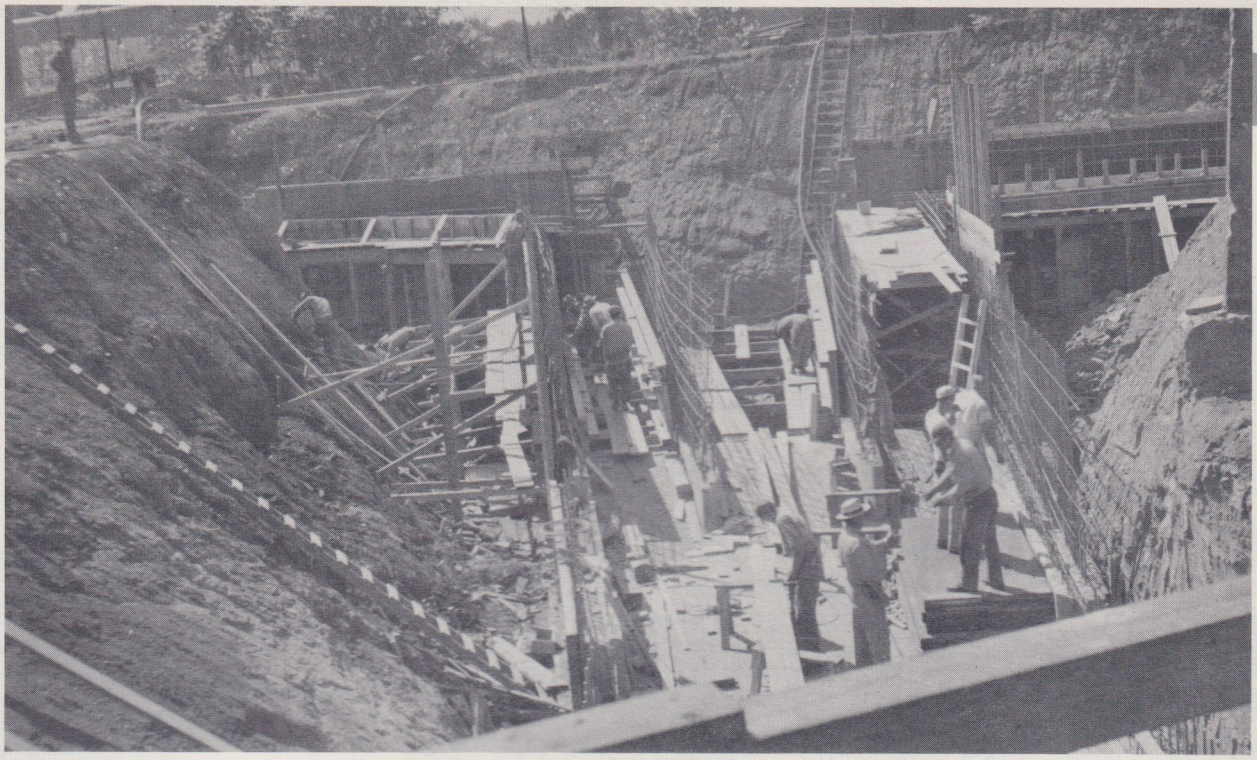
Finished 13-foot sewer.

or more greater than that for sanitary flow alone. Selection of the proper size depends on the probable severity of storms as figured from past records, on the proportion of hard surfaces in the area to be drained, and on the rapidity with which the rain water can reach the sewers. An average heavy storm is chosen as a standard. Also, a reasonable estimate of the future use of land must determine the run-off from impervious surfaces. Thus, any major change in land use, such as frequently occurred in war time, can make a sewer inadequate which might otherwise be large enough for a long time.

MAP SHOWING
MAIN OUTFALL SEWERS
TWO FEET DIAM. & LARGER

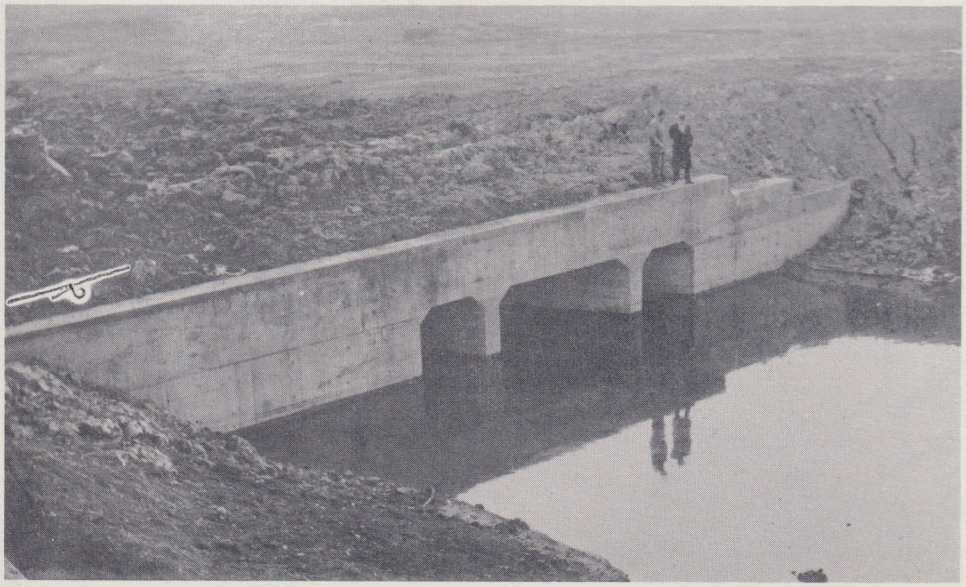
SEPTEMBER, 1950
REVISED JULY, 1955

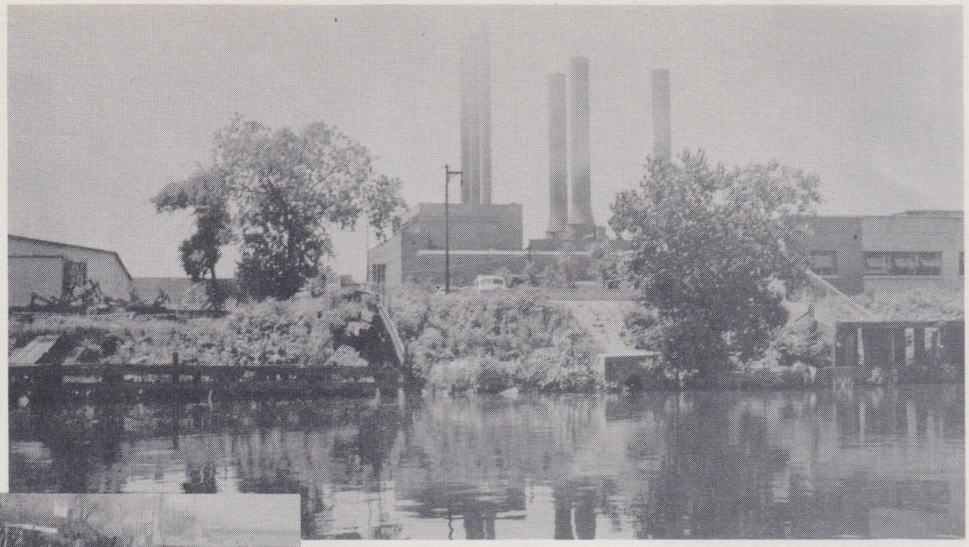


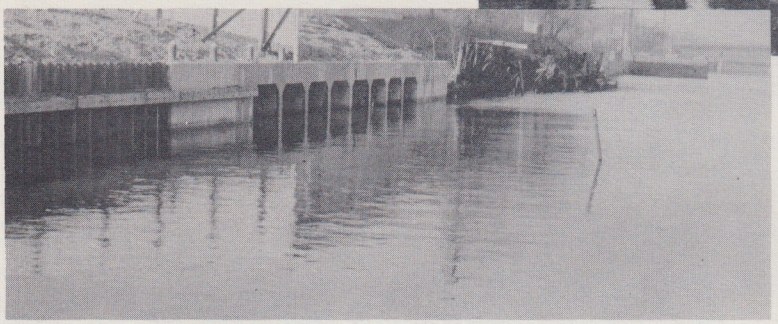


Building 3-barrel outfall, Addison St.—1947. Earth wall in background protects excavation from canal water which is 10 feet higher.

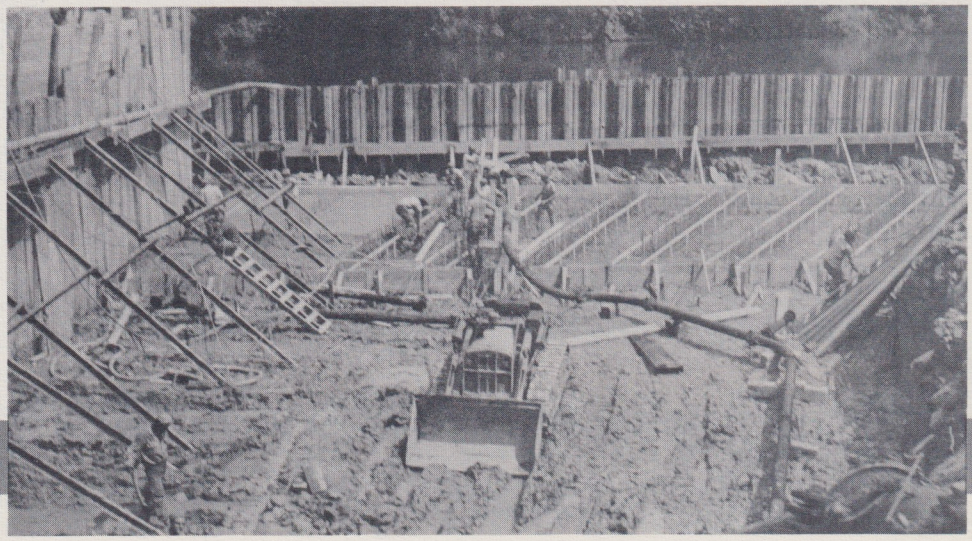
Addison Street outfall finished and earth wall removed.

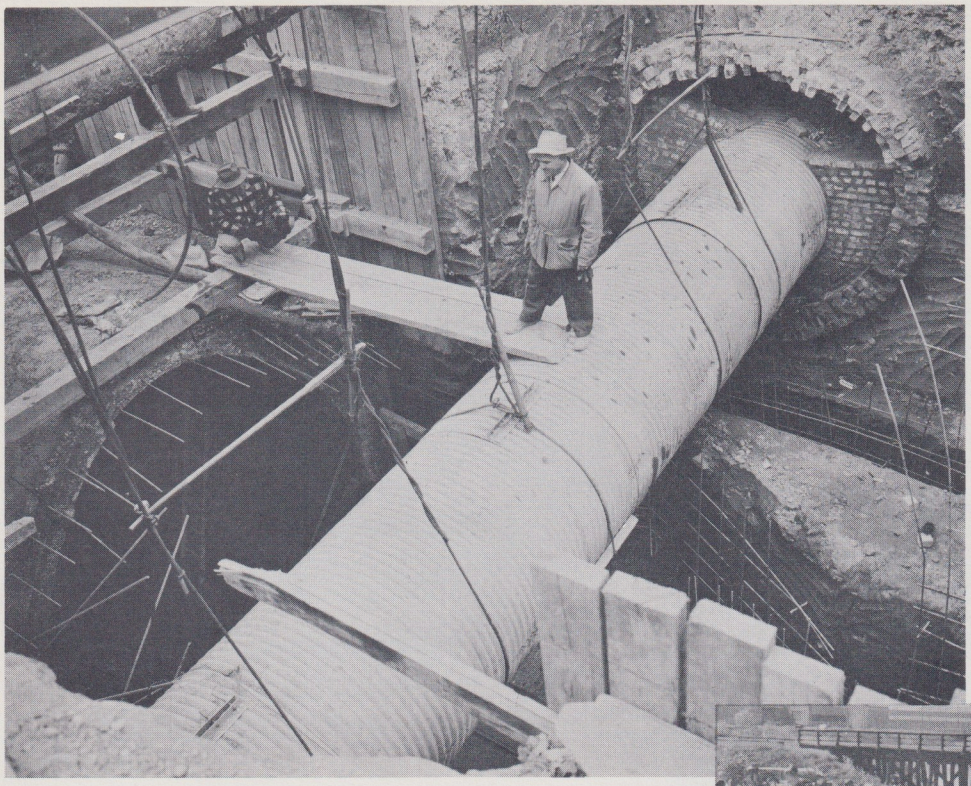






Upper Right: Site of Roscoe Street sewer outfall before new construction.
Left: Eight-barrel outfall completed.
Below: Excavation for eight-barrel outfall. Lower parts of forms for 5 barrels are being set.





Excavation and flume for connection of 8½-foot in Kilpatrick Ave. with Congress St. 13-foot.

3-way junction—31st and Albany Ave. Pipe to left is storm overflow to river.

A cause of sewer inadequacy in some local areas has been the stretching of the City limits to include fringe areas of a few acres or even a square mile or so. Frequently, these areas could be sewered only by extending the small ends of existing sewers not built to serve them. The result was inadequate service for the newcomers and over-loading of the old sewers. But the pattern could not easily be changed, at least not until the need over large contiguous areas warranted spending big sums to furnish relief.

The same consideration applies to most of the annoying and costly flooding of subways. The railroad tracks, when they were on the surface, naturally formed the boundaries of many drainage districts. When the tracks were elevated, only the small upper-end sewers were available to drain the underpasses, and these were built low, to save the comparatively small expense of higher track elevation. Also, subway floods are often aggravated, not by the incapacity of sewers but by the stoppage of street inlets with paper, leaves, and other debris washed to them over the surface by the rain water itself. This adds many unnecessary hours to the delays of traffic. Many of the worst cases of subway flooding have been cured so far as sewers are concerned and others will follow, but only cleaner neighborhoods will cure the stoppage of the inlets.

1856 - 1956

One common cause of flooding, in newer areas has been the popularity of houses built close to the ground but provided with full depth basements. In districts where sewers are obviously not deep enough to insure freedom from floods, or have insufficient capacity for some of the reasons noted above, this style of building is dangerous in spite of its appeal and, at times, its sale amounts almost to fraud. Many home buyers appear to have the impression that, if a sewer exists in the street, any home anywhere may be bought and have its basement lavishly furnished without inquiry as to possible flooding.

In this connection, also, it needs to be said that there are limits to the size of sewers. In some cases, if any attempt were made to carry away water from the worst possible flood, large trunk sewers would occupy the entire street to the exclusion of other service facilities. This was evident in 1954 when Chicago and

CONNECTIONS LARGE AND SMALL

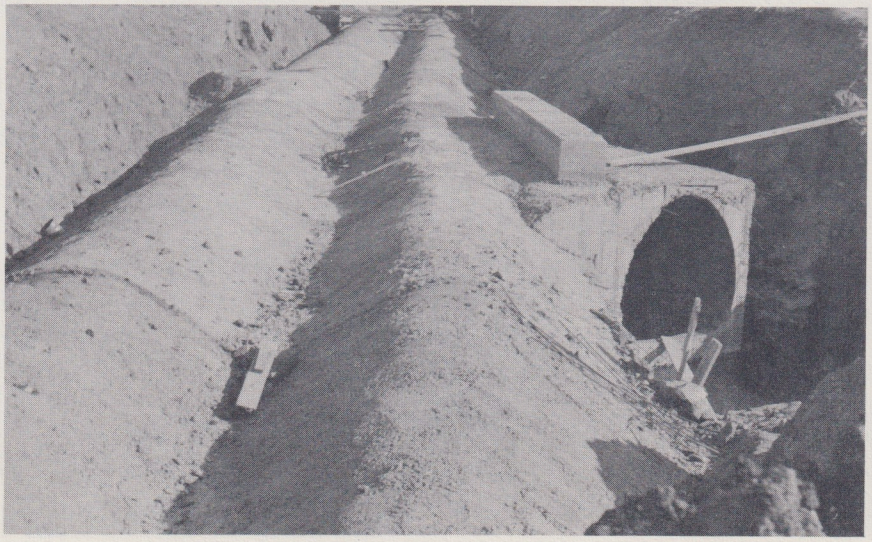
the near suburbs poured enough water into our river and canal system to raise them five to eight feet above normal. In other words, it must be remembered that our Chicago River and artificial channels are subject to overflow, as are rivers all over the world. The only safe way is to be above the floods and these will occur more and more often even in the suburbs, so long as people build closer and closer to the streams in making use of their property. Narrowing of the flood channel destroys the capacity of the natural basins to store the flood water and forces it to rise in the channels. We should be thankful that so much river frontage in Cook County is in the Forest Preserves where this sort of thing can be prevented.

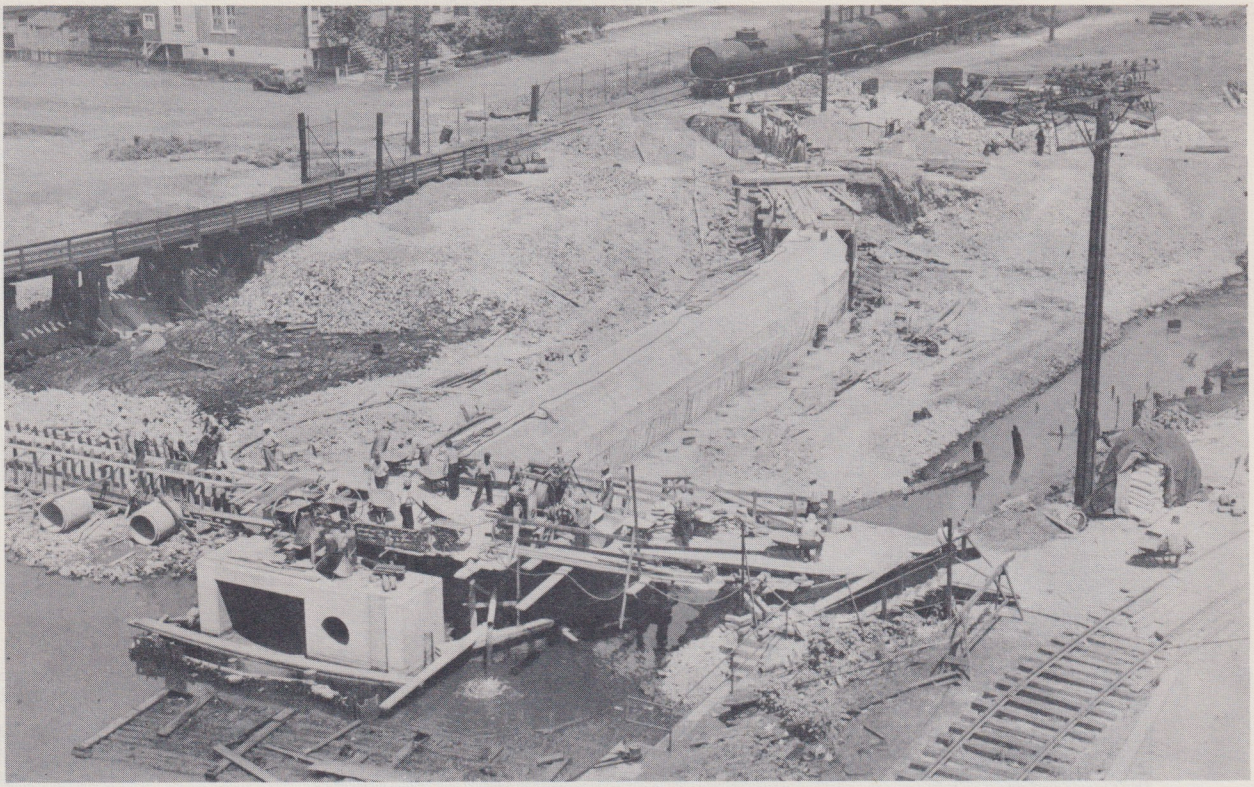
Making 6-inch and 8-inch connections to large concrete sewer for house drains and street catch basins.

Maintenance of 3600 miles of sewer is a major operation even though it consists mostly of thousands of minor ones every year. For example, in answering several complaints from a single locality, a cleaning crew may find that curious boys have dropped long sticks through the "finger hole" in a manhole cover when trying to find how deep the sewer is. These sticks have started forming a dam so that, after a while, even a small rain backs water into basements. Tree roots can do the same thing to sewers as large as two feet if they can find a quarter-inch hole through which to enter.

In industrial areas, large amounts of gritty and greasy dirt fill the catch basins and make frequent cleaning necessary although, in residential streets, these basins may often go for many years with no need for service.

12 x 12-foot twin-barrel in Roscoe St. near Drake, and same at junction for branch in Drake Ave. Multiple barrels are used when top of single barrel would be too close to street surface.





Extending Albany Av. 9-foot outfall to allow opening of 31st St.—1936.

Frequently, restaurants and food processing plants and other industries discharge hot liquids which deposit grease on the cooler walls of the sewer, finally choking it completely. This is a condition of which the guilty parties themselves are often the victims but which, in any case, means frequent scraping jobs for sewer crews.

In the amendment to motor-fuel tax laws, referred to earlier, the State Highway Division was authorized to allot fuel-tax funds for cleaning and repair of sewers and appurtenances in state highways and arterial streets. A "Motor-Fuel" Section is set up in the Bureau of Sewers to do this work.

As the sewer system gets older, many repairs must be made, especially to brick sewers built to bear the weight of only five or six tons drawn by horses. Today, empty trucks weigh as much as 10 tons and carry a 10-ton load at 10 times the speed of wagons.

With occasional new construction (mostly small, short sewers and street basins for extra drainage,) this cleaning and repairing requires a labor force of 600 or 700 men and nearly 100 trucks and such equipment as air compressors and tools; excavating, sewer cleaning and basin cleaning machinery, and large-capacity flush tanks. Emergency crews are always on duty at a central yard. Among other calls, they answer from 20 to 60 major fire alarms per year with the job of keeping sewer inlets open and assisting where needed.

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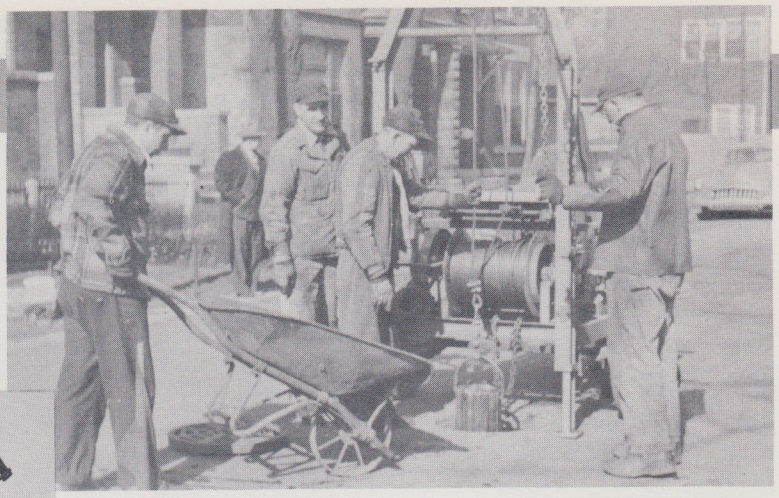
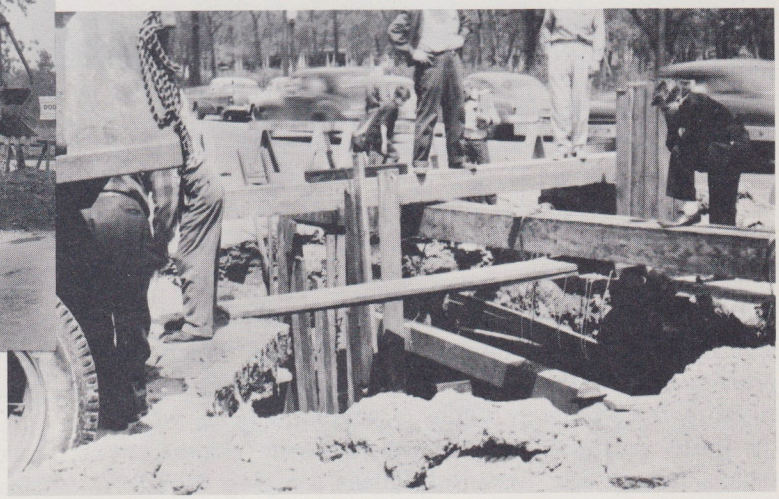


Sewer cleaning machine.

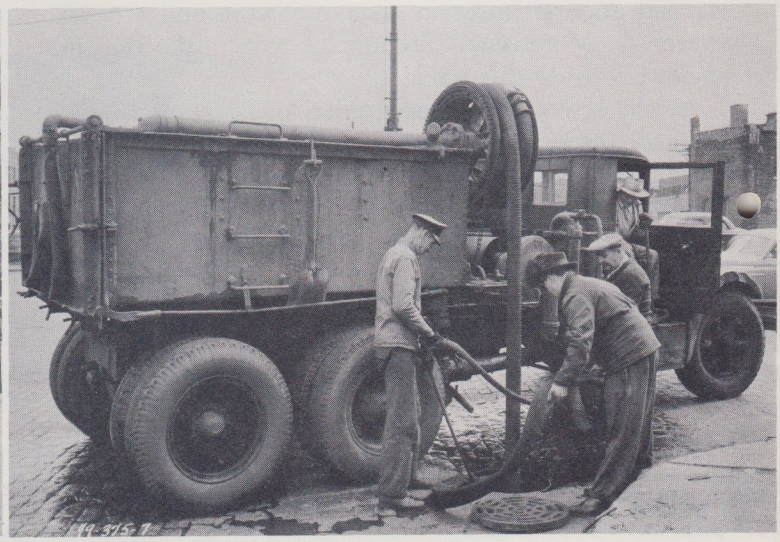
Clam-shell excavator.

Major repairs at 57th St. and Stony Island Ave.



Demolition unit—Air compressor and crane.

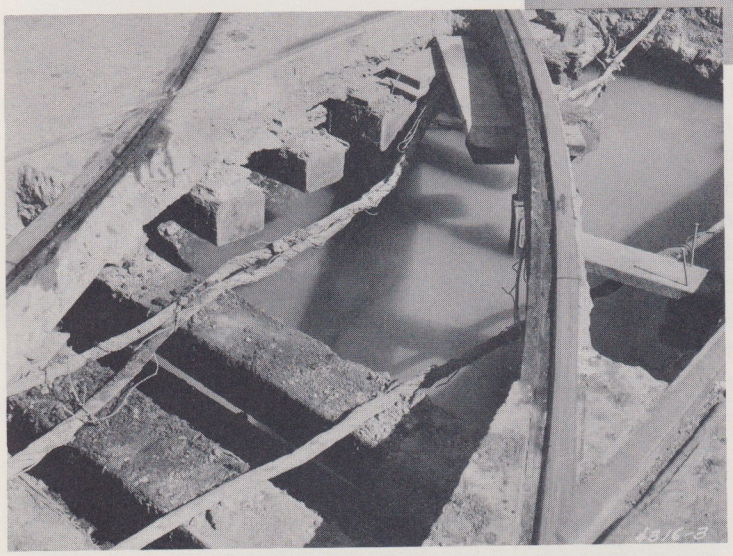
Catch basin eductor.



57th St. and Stony Island Ave.

Minor repair of 3-foot brick sewer.

Starting a repair job.



A tight fit under car tracks.

MAINTENANCE AND REPAIR

The Bureau of Sewers, in its work, has contacts with everybody living or carrying on operations in the City up to and including the National Government. This is because all work pertaining to sewers comes to the attention of the Bureau of Sewers under the law. To originate some of this or to pass upon that done by others, the bureau is organized with a Deputy Commissioner for Sewers, under the Commissioner of Water and Sewers, and with an engineering, clerical and inspection staff of about 150. During 1955, over 21 miles of sewers (a better-than average amount) were added to the system as per plans originated or approved by the Bureau; and of 12,400 work permits issued, 10,800 were for new home or other building connections.

Originally, besides the work of maintenance, the preliminary surveying and planning for sewers and the supervision of their construction was a part of the work of the Bureau of Sewers. At one period (1901-1940) this was done by the Board of Local Improvements, but the work and part of the staff was returned to the Bureau of Sewers for the next 13 years—including the first seven years of bond-issue work. In 1953, a new Department of Water and Sewers was formed as an operating and maintenance unit, and the planning and building of sewers by bond financing was retained in the Department of Public Works as part of a city-wide Capital Works Program. Under this arrangement, control of the sewers is turned over, after construction, to the Bureau of Sewers for maintenance.

Next to providing a sufficient supply of good water is the problem of handling it afterward as sewage whether it has been used for domestic purposes or in industry. This includes treating the sewage so that it may be returned to the streams as clear water and includes also, disposal of the sludge resulting from the treatment. Since many towns besides Chicago are involved, this treatment and sludge disposal are the work of the Sanitary District, but to deliver the sewage from every home or other building in Chicago to the District's intercepting sewers, is the City's job.

This can happen.

10½-foot Rockwell St. sewer at 31st St. in close quarters.

A hundred years ago, the pipes to furnish water and the sewers to dispose of it were the only equipment under the City's unpaved streets. Today, in sizes many times larger, these facilities must compete with the ever expanding underground lines of the telephone, telegraph, the electric power and light and gas companies, and the lighting systems of the City and Chicago Park District, and other underground structures. And this is now under heavy-duty pavements which make access for repairs the more difficult.

As a matter of maintenance alone, Chicago's Sewer System involves almost a thousand men and $6,000,000 a year; as a matter of continuous expansion and necessary replacements, it involves intricate planning by capable engineers and huge construction by experienced contractors, running to many scores of millions.

The system as it exists, without counting the hundreds of millions spent by the Sanitary District for the same cause, has cost $160,000,000. By the best estimates, its replacement today would run to nearly $500,000,000 or three times its original cost.

"Well-points" to de-water wet trench.

chicago sewer system centennial

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